BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking Regarding Policies, Procedures and Rules for Development of Distribution Resources Plans Pursuant to Public Utilities Code Section 769.	Rulemaking 14-08-013 (Filed August 14, 2014)
And Related Matters.	A.15-07-002 A.15-07-003 A.15-07-006

(NOT CONSOLIDATED)

In the Matter of the Application of PacifiCorp (U901E) Setting Forth its Distribution Resource Plan Pursuant to Public Utilities Code Section 769.	A.15-07-005 (Filed July 1, 2015)
And Related Matters.	A.15-07-007 A.15-07-008

PACIFIC GAS AND ELECTRIC COMPANY'S (U 39 E) ICA REFINEMENTS ANNUAL REPORT

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Dated: February 28, 2022

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PACIFIC GAS AND ELECTRIC COMPANY'S (U 39 E)
ICA REFINEMENTS ANNUAL REPORT

Pursuant to D.17-09-026, Pacific Gas and Electric Company ("PG&E") provides this Integration Capacity Analysis ("ICA") Refinements Annual Report ("Report") to the California Public Utilities Commission ("Commission"), as directed by the Administrative Law Judge ("ALJ") September 9, 2021 Ruling. This Report outlines PG&E's the timeline and milestones to implement the modeling changes as directed in the September 9, 2021 Ruling, presents analysis details on Grid Needs Assessment ("GNA")/ICA differences, and discusses whether further alignment of assumptions and methodologies could improve ICA results. Additionally, this Report provides an updated Uniform Load ICA method summary that identifies new data

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validation methods and proposes methods to enhance ICA accuracy. The Report is attached as an appendix to this pleading.

Respectfully Submitted,

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APPENDIX

PG&E ICA REFINEMENTS REPORT

Together, Building a Better California

February 28, 2022

Executive Summary

Pacific Gas and Electric Company (PG&E) hereby submits its February 2022 Integration Capacity Analysis (ICA) Refinements Report as directed by the Administrative Law Judge (ALJ) Ruling from September 9, 2021, in the Distribution Resources Plan (DRP) Order Institute Rulemaking proceeding (R.14-08-013).

PG&E presents its respective workplan that addresses the timeline and milestones to implement the modeling changes listed in the ALJ Ruling. PG&E has reviewed the ICA and the Grid Needs Assessment (GNA) assumptions and methodologies. Also, PG&E has conducted further analysis to address differences between the GNA and ICA results. This report presents PG&E analysis details on GNA/ICA data differences and discusses whether further alignment of assumptions and methodologies could improve ICA results. This report also provides an updated Uniform Load ICA method summary that identifies new data validation methods and proposes methods (including quantitative metrics) to enhance Load ICA accuracy.

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1. Data Quality Improvements Efforts

1.1. PG&E's ICA Continuous Data Quality Improvements:

PG&E has an ongoing effort to improve the quality of its system data. Figure 1 compares the distribution of the published results for ICA uniform load for the entire network in PG&E service territory, which demonstrates continuous improvements of the results. Since December 2018, uniform load results have increased. However, since February 2020, results have been consistent. This consistency in results demonstrates the robustness of PG&E data quality improvement process.

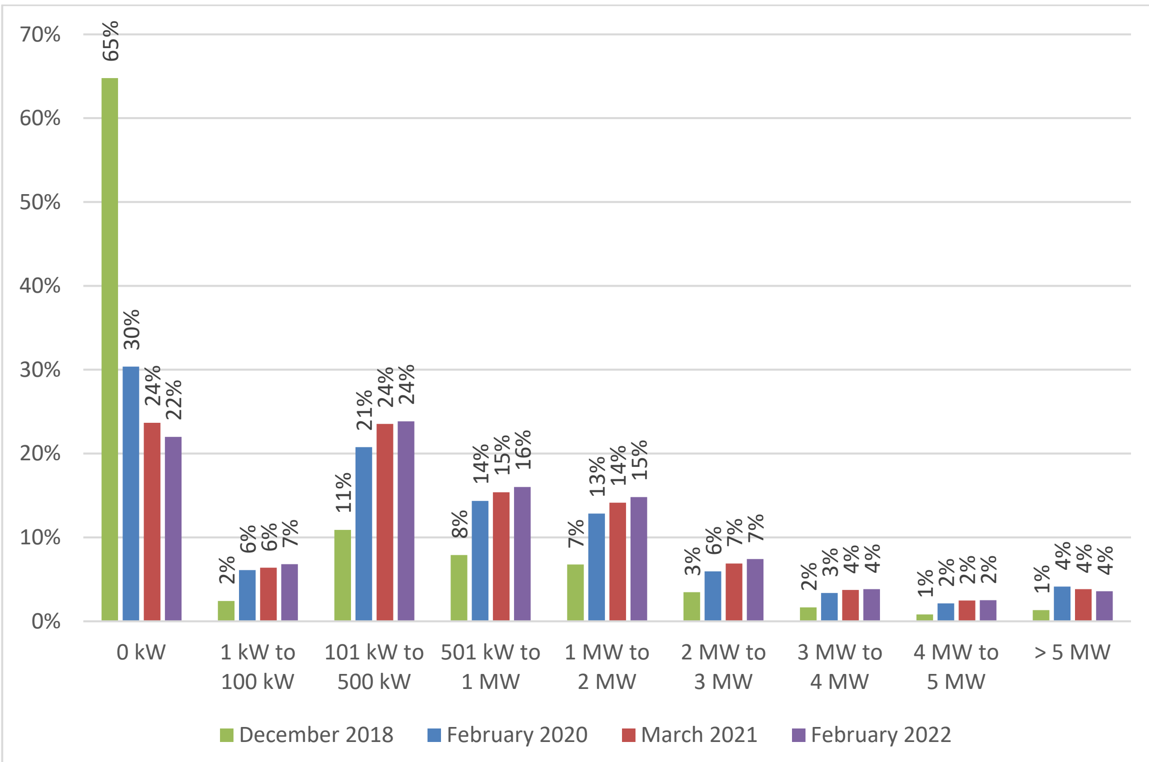

Figure 1: Distribution of uniform Load ICA results, demonstrating continuous improvement of the PG&E ICA data quality

1.2. Report on the Implemented Data Quality Improvements:

PG&E has recently improved some aspects of the ICA process after filing its data validation advice letter[1]. The enhancements are listed below:

- Decreased the lower limit of the Steady State Voltage Criteria from 119 V to 118 V, effective November 16, 2021, as ordered by ALJ's ruling ordering refinements to load integration capacity analysis.[2]
- Developed a spreadsheet according to the Independent Technical Expert (ITE) recommendation, which lists the circuits failed in different study cycles. This lists the feeder ID, feeder name, assigned engineer, study cycle, the stage the circuit is failed at, failure message, root cause, source of issue, etc. This tracker will help identifying

[1] PG&E Improved ICA Data Validation Plan, Advice Letter 6212-E, May 28, 2021

[2] Administrative law judge's ruling ordering refinements to load integration capacity analysis, Rulemaking 14-08-013, September 9, 2021.

the positive or negative trends related to input data quality and inform the root cause analysis. PG&E distribution engineers have reviewed more than 1,000 failed circuits in the past 6 months, which accounts for approximately 30% of PG&E entire territory.

- Changed the process to store and call for device settings in ICA platform as outlined previously in its improved data validation plan. PG&E has started using Powerbase instead of EDGIS for device settings. Powerbase takes the actual settings file for devices directly from the field personnel for relays, line reclosers, regulators, and capacitors settings at the time of installation. The software has multiple file management capabilities, e.g. who created the file, which field personnel installed it, which hardware and software version are at the device. Therefore, it eliminates manual errors. The CYME gateway will receive the data directly from Powerbase and prepare CYME models automatically based on that information. Also, Powerbase saves all the previous settings. Therefore, engineers will have access to historical settings, when any changes happen, and who made the changes. This ensures that ICA platform will have the most updated and accurate device setting data.
- Reduced the time between load profile updates from a maximum of 12 months to 2 months. PG&E started utilizing a moving 12-month window for load data as of January 10, 2022. PG&E will use most recent historical load profiles, only with two months delay for ICA calculations. For example, for studies performed in January 2022, data from 11/1/2020-10/31/2021 is deployed. Please refer to Section 2.2.3 for more information.

1.3. Additional Plans for Data Quality Improvement:

This section presents new areas of data quality improvements that PG&E plans to implement:

- PG&E has identified that a periodical/scheduled process to update the feeder and bank capabilities database could reduce the burden for distribution engineer's workload, whom need to review the failed circuits and manually fix data quality issues. PG&E is working to create a semi-automated process to update the capability database. This initiative will help to improve data quality for ICA results.
- PG&E is developing a process to automatically assign the failed circuits to the responsible engineers, after initiation of each study cycle. PG&E is developing metrics to assess the responsible engineers' performance to resolve the data quality issues on a timely manner. The metrics will be exported periodically in a report format to inform the ICA business owner and the PG&E management team to ensure quality of their performance.
- PG&E has initiated compiling a list of differences and is actively reviewing the reasons of difference between ICA and GNA as discussed in more details in Section 2.4.1. This initiative will help to improve data quality for ICA results.

2. Investigation of ICA and GNA methodologies and assumptions

This section conducts further analysis to address the difference between GNA and ICA results. The analysis is focused on the following two topics:

1. Whether alignment of ICA and GNA assumptions and methodologies could improve ICA results
2. Identify any new data validation methods and propose methods (including quantitative metrics) to enhance ICA accuracy

PG&E herby summarizes the assumptions and methodologies of GNA (Section 2.1) and ICA (Section 2.2), and the purpose of each study. An extensive comparison of the assumptions, methodologies, and root cause analysis of difference between ICA and GNA results can be found in Section 2.3. Some recommendations to improve the quality of ICA and GNA results as well as to reduce the difference between the two datasets are presented in Section 2.4.

2.1. Grid Needs Assessment Methodology & Process

The objective of the GNA is to provide transparency into the assumptions and results of the distribution planning process that yield the list of Candidate Deferral Opportunities. PG&E's GNA presents data available regarding PG&E's projected distribution grid needs over a five-year planning horizon.

The study methodology and assumptions used in GNA are discussed extensively in PG&E's 2021 Distribution Grid Needs Assessment final report[3], but are summarized below for the purpose of this report.

2.1.1. Grid Needs Assessment Scope

PG&E's 2021 GNA includes substation/bank, feeder, and line section needs. As adopted in D.18-02-004[4], grid needs that are reported in the GNA submittal are limited to the forecast deficiencies associated with the four distribution services that DERs can provide as adopted in D.16-12-036[5], which are distribution capacity, voltage support, reliability (back- tie), and resiliency (micro-grid).

The GNA is an output of the distribution planning process (DPP). The DPP evaluates future system deficiencies given forecasted load and DER levels and proposes planned investments to mitigate the identified grid needs. GNA data represents grid needs after engineers have maximized utilization of existing equipment but does not account for planning investments proposed on the associated circuit/substation. Therefore, GNA would indicate where planned investments are required to continue to operate the system safely and reliably.

2.1.2. PG&E's Distribution Resources Planning Horizon

To align with the circuit-level planning assumption requirements provided in D.18-02-004 Section 3.4.1.1, PG&E used a five-year forecast as the study horizon for identifying substation and feeder grid needs. PG&E applies a 10-year planning horizon for Pre-

[3] PG&E'S 2021 Distribution Deferral Opportunity Report, August 16, 2021, Available here: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M400/K593/400593924.PDF

[4] Decision on Track 3 Policy Issues, Sub-Track 1 (Growth Scenarios) And Sub-Track 3 (Distribution Investment and Deferral Process), D. 18-02-004, February 8, 2018 Available here: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M209/K858/209858586.PDF

[5] Decision Addressing Competitive Solicitation Framework And Utility Regulatory Incentive Pilot, D. 16-12-036, December 15, 2016, Available here: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M171/K555/171555623.PDF

Application Project needs. PG&E identifies line section Capacity and Volt/Var needs for a three-year period.

2.1.3. PG&E's Distribution System Load Forecast Assumptions

PG&E's load growth forecast begins with the most recent approved California Energy Commission (CEC) PG&E Transmission Access Charge (TAC) area Peak and Energy Forecast. The CEC approved IEPR forecast is typically used for GNA.

Transmission-connected load growth and known new distribution loads are deducted from the CEC system load growth forecast. The resultant growth is distributed out by customer class (residential, industrial, commercial, and agricultural) and is then allocated to PG&E's distribution feeders using geospatial analysis. PG&E uses a 1-in-10-year (90th percentile of high loading) weather event forecast regression curve as the basis for making decisions regarding planned capital upgrades and permanent load transfers.

2.1.4. PG&E's Distribution System DER Growth Forecast Assumptions

Separate from load growth, PG&E has incorporated DER adoption into its distribution bank and feeder forecast assumptions. This is accomplished for residential photovoltaics (PV), retail nonresidential PV, energy efficiency for different customer classes, electric vehicles (EV), energy storage charge and discharge, and load modifying demand response. The starting point for developing these feeder level DER growth forecasts is the CEC's California Energy Demand (CED) forecast that is completed at the systemwide level.

2.1.5. Methodology for Substations, Feeders and Line Sections

PG&E uses LoadSEER to turn the system peak growth amount into a 576-hour load shape that can then be applied to the feeder or bank load shape. LoadSEER creates two forecasts that can be compared: (1) a geospatial forecast derived from CEC system growth; and (2) a regression forecast based on multi variable analysis and fit with historical recorded loads. The creation of both geo-spatial load forecasts and regression forecasts provide PG&E's electric distribution planning engineers with two different yet statistically valid forecasts. If the results of both forecasts are similar, they provide PG&E's electric distribution planning engineers with greater confidence in the quality of both forecasts. Otherwise, the electric distribution planning engineers are directed to select the geo spatial forecast results derived from CEC load forecast.

After the 10-year load forecasts are created in LoadSEER, the distribution planning engineers make adjustments which are anticipated based on specific local information. As an additional step to the forecast process, PG&E's electric distribution planning engineers validate and adjust historical peak loads for distribution substation transformer banks and feeders within their local areas to establish a starting point for distribution loading projections.

PG&E uses the CYME Power Engineering Software for modeling line section demand forecasts and identifying line section needs. The feeder peak demand growth is applied to the corresponding feeder line sections over a three-year period.

2.1.6. Methodology for Voltage Support Needs

Voltage Support needs are identified using CYME Power Engineering Software and three-year forecast as described for capacity planning for line sections. As part of the annual distribution planning studies, PG&E forecasts voltage on all energized primary nodes for nearly every feeder for up to three years. PG&E identifies Voltage Support needs based on exceedance of Rule 2 voltage limits under normal operating conditions. To forecast Rule 2 voltage issues, PG&E conducts power flow studies assuming a 1-in-10-year load under normal feeder operating conditions. Since these planning studies are conducted under peak loading conditions, most if not all voltage issues materialize as voltage falling under the 5% nominal voltage Rule 2. Since simulated voltage results are provided for nodes on the distribution primary, an assumed voltage drop on the secondary is needed to define the primary lower limit.

2.1.7. PG&E's Load Transfers and Switching Assumptions

GNA load forecast includes the impact of future planned load transfers and switching operations that do not require a capacity project. The planned load transfers and switching operations are used to balance the load between feeders and banks. GNA identifies grid needs that require a capacity project to either directly mitigate a need or to enable distribution switching and load transfers that mitigate the need.

2.2. Integrated Capacity Analysis Methodology & Process

The ICA methodology provides transparency into evaluating distribution system limits to host DER across the entirety of a utility's service territory. The methodology has two main goals to ensure a successful and scalable analysis for the interconnection of a DER which are (1) streamlined efficiency and (2) improved detail and granularity.[6] The ICA results provide transparency to the "current state" of the distribution grid and inform probable results of the interconnection process that an interconnection project may encounter.

Load ICA is evaluated at each three-phase node through the iterative process. The Load ICA is performed by iteratively increasing the amount of load at each three-phase node until a criteria limit is exceeded. The maximum amount of load that did not exceed a criteria limit is recorded as the load ICA result for that node, hour, and criteria. The iterative process then moves to the next three-phase node and repeats the process until the analysis is completed for all three-phase nodes. This process is illustrated in Figure 2. The entire process will be repeated for 576 hours, that represents 24 hours, 12 months, and maximum (90th percentile) and minimum (10th percentile) load.

The current ICA models represent the normal configuration of the circuit "as is". The uniform load ICA results represent the maximum uniform load at the point of interconnection without violating the thermal, voltage variation, and steady state voltage limits among 576 hours scenarios.

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[6] PG&E Integration Capacity Analysis for Distribution resource Planning, Demonstration A. Available here: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M168/K257/168257411.PDF

Power system equipment and line-sections ratings establish the thermal limits for load ICA. In cases where the load ICA results exceed circuit or substation transformer bank ratings, the load ICA results will be reduced to the circuit or substation transformer bank rating.

To accurately model the PVs, PG&E has developed typical PV output profiles. This profile follows clear sky irradiance data from NREL (PVWatts). PG&E applies the irradiance profiles to the nameplate capacity (e.g. kilowatt or megawatt). This creates a profile for each PV generator. Non-PV Generators are modeled at 100% of their nameplate. The queued generation is not modelled in the Load ICA.

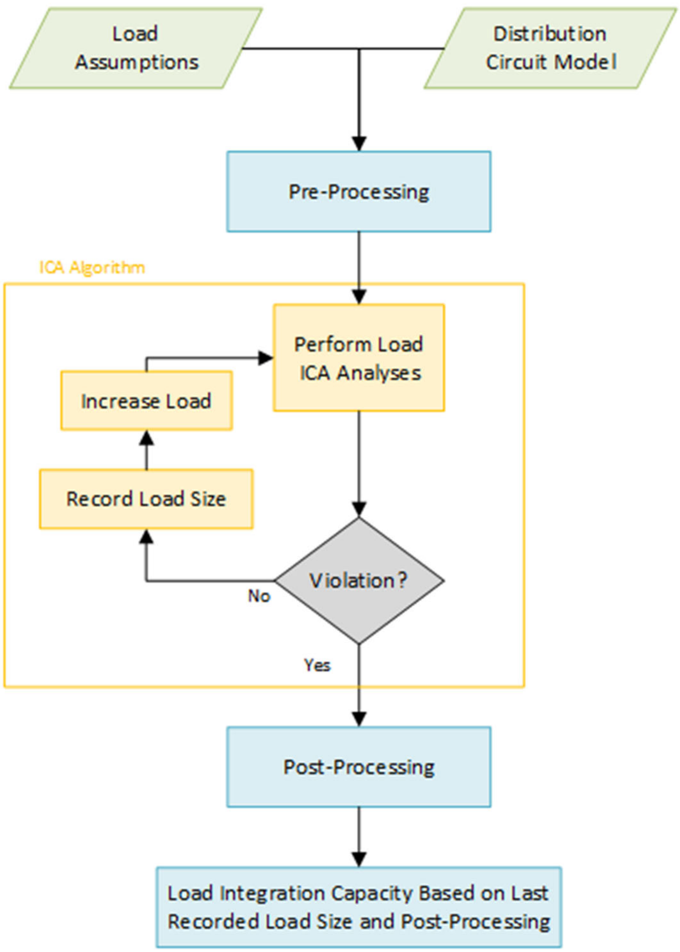

Figure 2: Iterative Load ICA methodology

2.2.1. ICA Analysis Scope

As identified by R.14-08-013 ICA working group, there are two primary use cases for the ICA. The first and most developed use case for the ICA is to improve interconnection, which includes a more automated and transparent interconnection process and the publication of data that helps customers design systems that do not exceed grid limitations. However, the findings of the formal interconnection process evaluated by a planning engineer will always supersede the values published in the PG&E ICA public map. The second use case is to utilize ICA to inform distribution planning processes to help identify how to better integrate DERs into the system.

Load ICA values represent the incremental capacity that is available on the distribution system within equipment ratings, through iterative power flow calculations. Current Load ICA calculation is based on the existing system configuration and historical load data, while the future Load ICA, which would incorporate the refinements proposed by the Ruling, will be calculated based on planned system configuration with forecasted load and distributed energy resources (DER) and all the proposed planned investments.

2.2.2. PG&E's ICA Purpose and Limitations

ICA study results indicate grid limitation and hosting capacity for load at the time of publication. This is mainly because ICA uses historical data of the previous year and is not designed to identify grid needs for the future load growth.

2.2.3. PG&E's ICA Load Data Assumptions

ICA uses a 12-month historical moving window to collect 90th and 10th percentile loading for circuits, banks, and customers. Using these, a 576 representative historical time-series for load is developed. The moving window for historical load profile ensures that PG&E uses the most up to date loading information, only with two months delay for ICA calculations. For example, for studies performed in January 2022, data from 11/1/2020-10/31/2021 is deployed. This process is illustrated in Figure 3.

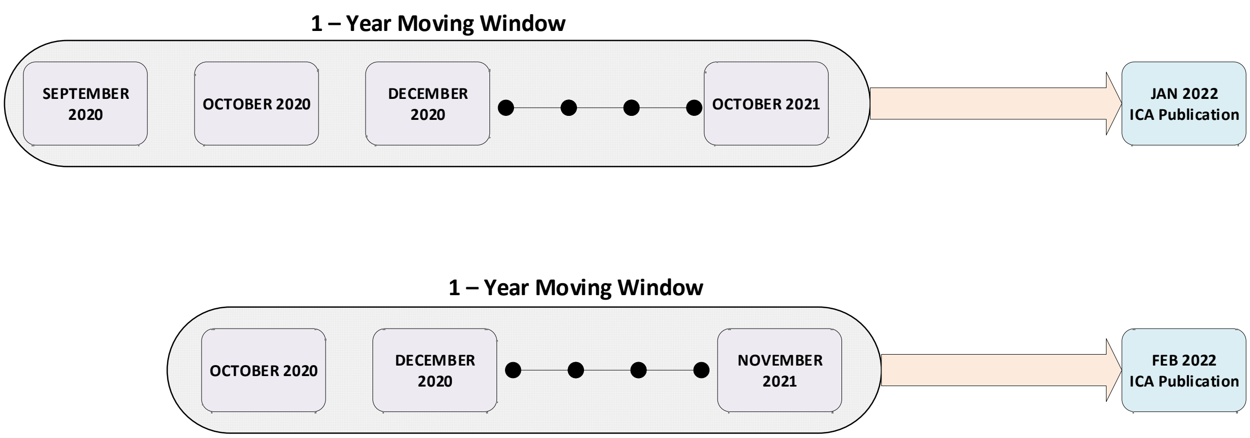

Figure 3: The 12 months historical load data moving window

ICA is not a planning process and hence does not use forecasted load profiles, currently. As such, the Rule 21 tariff orders the IOUs to use historical 12-months data for interconnection use cases, comparing the generating facility capacity to the minimum hosting capacity[7].

[7] Electric Rule No. 21, Sheet 156, Screen I "…This option requires the Generating Facility capacity to be no greater than 50% of Producer's verifiable minimum Host Load over the past 12 months."

2.2.4. PG&E's ICA DER Growth Forecast Assumptions

The current ICA methodology does not use any inputs for load or DER growth.

2.2.5. Methodology for Substations, Feeders, and Line Sections

PG&E captures load data through Advanced Metering Infrastructure (AMI). This method allows capturing the "net load" at the point of measurement. The data is then transferred to PG&E's load forecasting software "LoadSEER" on a regular cadence. PG&E uses LoadSEER to turn the 1-year historical bank, feeder, and customer loading into 576-hour load shapes used by the platform.

ICA then performs power flow analysis for 576 representative hours per year on three-phase circuit nodes to provide users with a directional understanding of where capacity for additional load may exist based on the current system configuration. Capacities shown do not reflect constraints that may be present at higher levels of PG&E's system, e.g., transmission system.

2.2.6. Methodology for Voltage Criteria

Bank-level loading obtained through either the Supervisory Control and Data Acquisition historian system or monthly recorded substation metering data is used to develop settings that output 122 V at minimum loading and 126 V at maximum loading. Hence, ICA uses different voltage output at substation for different hours.

Voltage violations are identified using the power flow results of CYME Power Engineering Software for each of the 576 representative hours. The amount of load which can be installed without causing primary voltage to deviate from Rule 2 limits at the customer premise is checked. Rule 2 customer service voltage limits are 5% of the nominal voltage. (i.e. 114-126V on a 120V base). PG&E considers voltage limits of 118-126.5 volts on the primary network to allow for the secondary voltage drop. Also, the amount of load which can be installed without causing a 2.5% variation in voltage levels is checked.

2.2.7. PG&E's Load Transfers and Switching Assumptions

ICA does not identify capacity deficiencies to either directly mitigate or to enable distribution switching and load transfers caused by contingencies and switching operations. Also, the current ICA methodology does not consider future planned load transfers and switching as inputs.

2.3. Comparison of ICA and GNA Assumptions & Methodology

The ICA and GNA studies are different in focus as shown in Table 1. Also, since the study purposes are different, their assumptions and methodologies are different as highlighted in Table 2.

Table 1: Overall Comparison of ICA and GNA

Category	Attribute	ICA	GNA
General	Primary Use Case	Interconnection	Needs Assessment/DDOR
	Study Horizon	Near-term	5 years
	Study Granularity	Line section	Line Section
	Study Range	Single feeder	Distribution Planning Area
	Study Output	Load or Generation hosting capacity	Capacity deficiency over planning horizon;
	What question is answered?	How much capacity is left?	How much extra capacity is needed?
Analysis	Type	Screening	Planning
	Scope	Does not include switching/load transfer studies	Includes switching/load transfer studies
	Criteria	Thermal Violation Steady State Voltage Violation Voltage Fluctuation (Flickers) Operational Flexibility Available capacity for generators System impact of generation Minimum Fault Level Equipment interrupting rating	Thermal Violation Steady State Voltage Violation System impact of generation Equipment interrupting rating
Publication	Platform	Grid Unity, CYME, LoadSEER	CYME, LoadSEER
	Update Frequency	Monthly	Annual
	Confidentiality	Confidential customer information is redacted	Confidential customer information is redacted
	Format	Online Map, API, Downloadable	Online Map, Downloadable

Table 2: Comparison of ICA and GNA assumptions

	ICA	GNA/DDOR

Loading Conditions	• 576 hours of historical time-series analysis
	• 90th and 10th percentile loading based on circuit-level shapes and AMI load
		• Single hour, peak loading condition
		• Forecast trajectory informed by IEPR
		  • 10 years for feeder/bank
		  • 3 years for line-section

Study Cases	• 576 hours	• Single hour
Load Interconnection	• Known new load projects are not modelled	• Known new load projects are modelled
System Configuration	• System topology in its existing, normal configuration, as switched	• Planned system reconfiguration and upgrades (as planned), for the next three years

Bank Voltage Selection	• Variable bank voltage for each hour, calculated as follows:
	  • Bank voltage is 122 V at minimum load
	  • Bank voltage is 126 V at maximum load
		• Bank voltage is 126 V for peak hour loading

	• Bank voltage is interpolated proportional to load[8]	
Distributed Energy Resources	• Existing DER connected to the system with permission to operate; but set to zero since they materialize in metered net load • Queued generation is not modeled	• Existing DER connected to the system with permission to operate; but set to zero since they materialize in metered net load • Queued generation is not modeled
Substation	• Disconnect capacitor banks and series reactors, that used for the purpose of transmission voltage correction	• Disconnect capacitor banks and series reactors, that used for the purpose of transmission voltage correction
Voltage Regulation Devices	• Regulators and switched capacitors are allowed to change state based on conditions in each of the 576 scenarios	• Regulators and switched capacitors are allowed to change state based on a single peak scenario
Thermal Limits	• Equipment (bank, cable, line-section limits are identified using LoadSEER and CYME • Accounts for other limitations such as underground cable temperature and protective devices in the field (83% of the phase overcurrent value)	• Equipment (bank, cable, line-section limits are identified using LoadSEER and CYME • Accounts for other limitations such as underground cable temperature and protective devices in the field (83% of the phase overcurrent value)
Voltage Variation Limits	• 3 V (2.5% of 120 V base)	• Voltage variation is not a part of GNA/DDOR process. • PG&E evaluates the voltage variation during the new business application review with 3 V (2.5%) limit on 120 V base.
Steady-state Primary Voltage Limitations	• Acceptable voltage: 118.0-126.5 V	• Acceptable voltage: 118.0-126 V
Protection	• Checks for overload condition, minimum fault level, and equipment interrupting rating	• Checks for overload condition and equipment interrupting rating.
Transmission Constraints	• Do not consider	• Do not consider

[8] $V = \frac{122}{120} + \left(\frac{126-122}{120}\right) * \text{LR}$
where:
$V = Bank\ voltage$ in per unit
Loading Ratio (LR) = $\frac{L-L_{min}}{L_{max}-L_{min}}$
L_{min} = Minimum loading
L_{max} = Maximum loading
L = Loading at that hour

PG&E's preliminary analysis shows that the variables that have the most significant effect to the difference of the ICA/GNA results are the following:

1. ICA uses historical load profiles, while GNA uses future load forecasts.
2. GNA uses SCADA data at the feeder head to determine the peak hour load, while ICA uses aggregated AMI data. This may lead GNA and ICA to select a different peak hour because the source data are not the same. The differences in source data can be attributed to line losses, VAR flow, missing data, etc.
3. The number of cases (load profiles) each study considers is different. ICA uses 576 hour loading data and the final ICA values represent the minimum ICA value among the entire 576-hour cases. GNA uses only one peak loading hour for its analysis.
4. In some cases, there are discrepancies in the data used for the GNA versus the data used for ICA.

Although the purpose of ICA and GNA are different, the results can be used in tandem to better understand the feasibility of projects. Due to the nature of the studies and some similarities in the two methodologies, a degree of alignment between the results is expected. In general, if a circuit's load ICA capacity is zero, it is expected that a grid need has been identified in the GNA study. Conversely, if a grid need is identified for a circuit in the next 2-year planning horizon, then the ICA result would be zero. There are exceptions to these basic rules; for example, a grid need would not be identified if a planned capacity project already exists. But the ICA analysis would show no available capacity on that feeder. However, in general, these rules should hold true. PG&E has started an extensive analysis of ICA and GNA results that violate these basic rules. Based on our primary analysis, the differences between GNA and ICA results can be classified under two categories:

1. Different assumptions or methodologies; specifically: loading condition, number of study cases, bank voltage selection methodology, DG and load queue.

2. Differences between the data and data quality used in the GNA versus the ICA.

2.4. Recommendations for Alignment of ICA and GNA

PG&Es supports modeling enhancements across GNA and Load ICA but concludes that the analyses in the GNA and Load ICA serve different purposes and, therefore, should maintain differences in assumptions and methodologies. PG&E finds that the input data used for calculations for the GNA and Load ICA, such as the forecast, planned projects, DER growth, etc., can be more aligned to maintain consistency with both calculations. Nevertheless, the objectives served by the GNA and Load ICA require different methodologies and assumptions. Whereas the GNA calculates when a demand forecast would exceed the ability to be served using existing equipment ratings and require mitigation, Load ICA calculates the available capacity on the system at present without requiring mitigation.

2.4.1. ICA Accuracy and Quantitative metrics

The methodology and metrics to evaluate the difference of the results are shown in Figure 4. PG&E has initiated compiling a list of differences and is in the process of reviewing the reasons of such differences. Since the sources of data (GNA and ICA results) are constantly changing, this must be an ongoing effort, which will eventually lead to more accurate results for both ICA and GNA. This is a resource and time-consuming effort; however, this will enable PG&E to not just track the current level of accuracy, but also to perform statistical analysis, and track how these process improvements will enhance the ICA accuracy over time. The methodology and the quantitative metrics will take a few years to mature, after which more targeted and informed alignments between GNA and ICA may be possible.

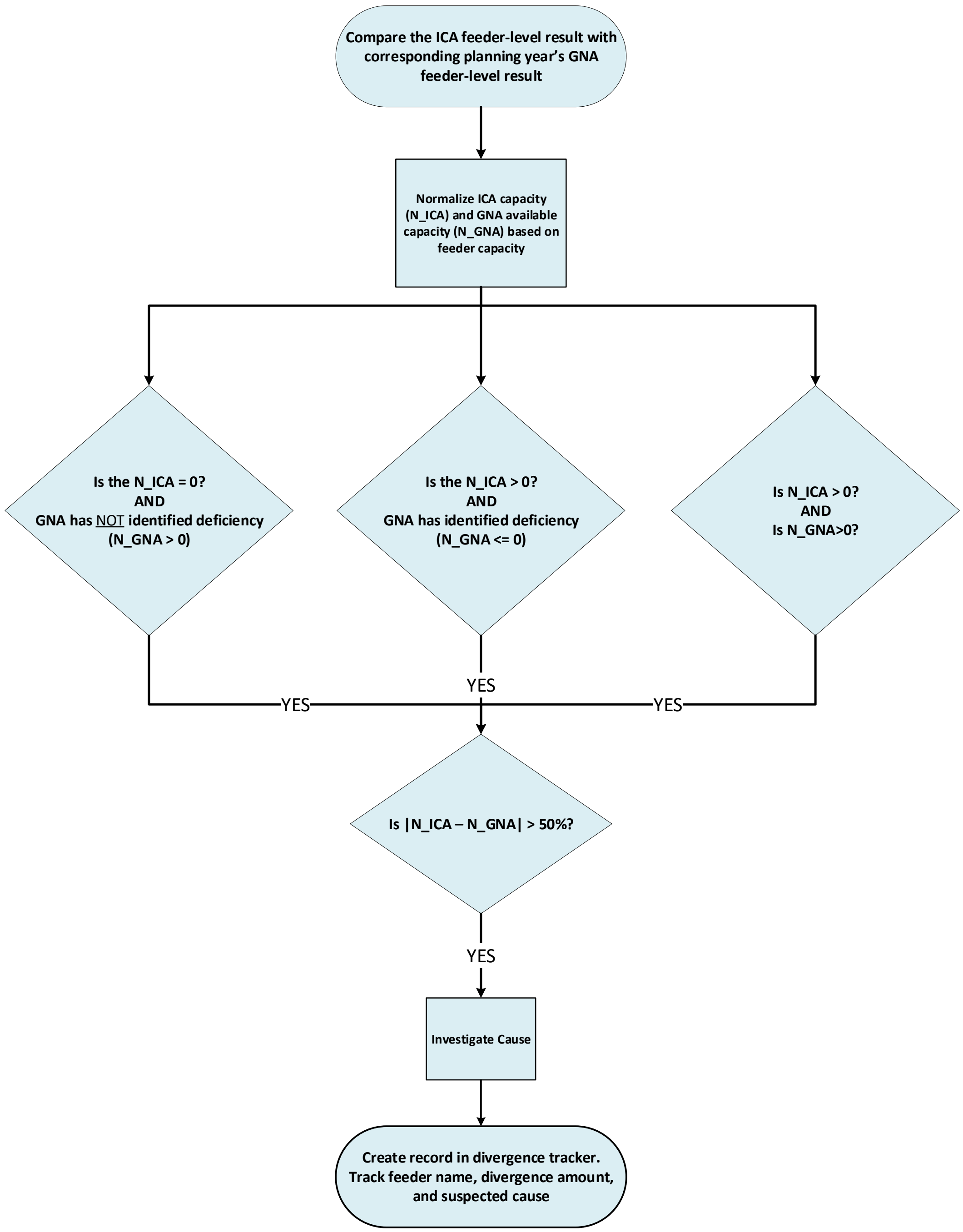

Figure 4: Developing quantitative metric for ICA accuracy

2.4.2. Recommendation to improve ICA accuracy

PG&E recommends the following after its preliminary analysis:

1. The September 9, 2021 ALJ Ruling ordering Load ICA refinements are helpful to reduce the difference between ICA and GNA results. This will be specifically achieved by reducing discrepancy between load, DER, and queued project assumptions. These refinements are sufficient in aligning ICA and GNA results, without confusing the essence of the two methodologies.

2. PG&E plans to focus the resources on data validation and enhancing the accuracy of the ICA results. The methodology shown in Figure 4 will inform the extent of differences and their root cause. Further alignment of ICA and GNA inputs and assumptions are not essential, until after the data validation and accuracy improvement of ICA are in mature stage. Apart from the addition of the quantitative metric shown in Figure 4 and PG&E's additional plans for data quality improvements outlined in Section 1.3, no changes have been identified and PG&E maintains the position that the data validation methods outlined in Advice Letter 6212-E-A are still the best approach to improve Load ICA accuracy.

3. ICA Refinements Workplan

The following refinements are required by the Sep. 9, 2021 ALJ Ruling as part of Load ICA refinements to streamline the EV infrastructure interconnection and California electrification goals. This section outlines the scope of the work, budget, and timeline to further develop ICA capabilities. Table 3 summarizes the refinements ordered by the California Public Utility Commission.

The refinements will be implemented to better align ICA and GNA inputs and assumptions. One of the key differences between the current ICA process and the future Refined ICA is that it will consider forecast data instead of looking at historical data. The Rule 21 tariff, orders the IOUs to use historical 12 months data for interconnection use cases, comparing the generating facility capacity to the minimum hosting capacity[9]. As the result, loading conditions for Generation ICA and Load ICA need to be different. As such, the Load ICA refinements are not applicable to Generation ICA. PG&E plans to completely decouple Generation ICA and Load ICA modules, since inputs and assumptions are different.

3.1. Refinement Item 1

PG&E's Load database will track pending applications from SAP. All load applications independent of type, size, and interconnection date will be added to the model for all 576 hours. The ICA platform will use the Load database to connect pending interconnection applications at the proposed location in each circuits' model. The pending loads will not be considered in all stages of the ICA calculations. For example, they are not considered in the generation ICA module. Also, for load ICA calculations, they are considered only in the ICA

[9] Electric Rule No. 21, Sheet 156, Screen I "…This option requires the Generating Facility capacity to be no greater than 50% of Producer's verifiable minimum Host Load over the past 12 months."

stage and not the Peak Load Allocation (PLA) and Hourly Load Allocation (HLA) stages[10], as these stages only verify the pre-existing violations.

To implement the ICA refinements, PG&E and any vendors need to upgrade their power-flow software (CYME) to version 9.0 or greater, to enable and disable modifications using Python scripting. This is planned for June 2022.

Table 3: Changes to Inputs and Assumptions to Load ICA

Refinement Items	Requirement	Details
1)	Model load ICA with all queued load projects.	• Secondary network such as secondary lines and service transformers will not be modelled. • All load applications independent of type, size, and interconnection date will be considered in the Load database. All 576 hours study cases will incorporate this database for system analysis. • After customer application is received and approved, the spot load at nearest CYME node, on the primary network, will be added.
2)	Model load ICA to include distribution system upgrades with an approved construction schedule and an in-service date within one year.	• All capacity planned projects are considered, independent of size or type (line-sections, transformers, feeders). • The projects will be modelled on and after the project implementation date.
3)	Model load ICA to consider forecasted DER growth.	• PG&E is planning to consider this only for the first year following the ICA study time stamp, since it is the output of LoadSEER and tied to the first-year load forecast.
4)	Model load ICA to consider planned network reconfiguration.	• This only addresses the planned network reconfiguration. Temporary network reconfigurations necessary for system operations will be excluded from load ICA models. • The planned network reconfiguration will be modelled on and after the implementation date.
5)	Model load ICA with load forecast for the next year.	• Similar growth forecast assumption and load conditions for GNA outlined in Sections 2.1.4 and 2.1.5 will be considered.

3.2. Refinement Items 2 & 4

The distribution system upgrades, and planned network reconfiguration will be available as inputs to the model. The configuration could be set that the automated process enters a time span input e.g., 1/1/2022-1/1/2023 and the database returns the relevant upgrades. PG&E is planning to consider a 12-month moving window of the input data for these items.

[10] PG&E Improved ICA Data Validation Plan, Advice Letter 6212-E, May 28, 2021

The new data is reflected in the ICA results for circuits that are triggered for the specific month during the process. This moving window will ensure that the ICA platform is always analyzing the system's data for the next 12 months from the study time stamp.

These changes to the inputs and assumptions require CYME 9.0. This is because the listed features are available under "chronological study" mode in CYME. Chronological studies tie modifications to an implementation date in CYME. Therefore, the changes are effective on and after the implementation date. For example, if a project is planned to be commissioned 6/1/2022, the power-flow scenarios that fall between 1/1/2022 and 5/31/2022 will not consider this planned project.

3.3. Refinement Items 3 & 5

This requires modifications to LoadSEER interface to CYME. The changes will enable the platform to request load profile for a time span in future, e.g., next year. The future information could include "DER forecast" and "load forecast". These modifications are dependent on implementation of PG&E Long Term Planning Tool (LTPT) and upcoming versions of LoadSEER. PG&E is planning to consider a 12-month moving window of the input data for these items. The new data is reflected in the ICA results for circuits that are triggered for the specific month during the process. This moving window will ensure that the ICA platform is always analyzing the system's data for the next 12 months from the study time stamp.

3.4. Study Trigger Criteria

Study trigger is the process to restart ICA calculations for feeders with changes above certain thresholds, such as equipment settings, load and generation changes, network topology, etc. The triggering criteria and thresholds need to be revisited for load ICA to consider changes implied by the new projects, new loads, and planned reconfiguration. PG&E expects that due to more frequent changes to the system, more frequent ICA studies are required to maintain an accurate dataset. PG&E estimates that the new Load ICA implementations may add about 50% to cloud computing resources. PG&E plans to ensure that ICA results will be refreshed at least once a year for the entire PG&E network, and more frequent for feeders with significant changes.

3.5. Clarifications on the Input Data

It should be noted that the ALJ ruling does not provide clear directions on the duration for which IOUs should consider queued load projects, forecasted DER growth, and distribution system upgrades. PG&E is considering these attributes for the first year, since the other attributes, i.e. planned projects, network reconfiguration, and load forecast components are considered for the first year ahead.

As such, PG&E is planning to consider a 12-month moving window of all 5 input data sets outlined in the ALJ Ruling. The new data is reflected in the ICA results for circuits that are triggered for the specific month during the process. This moving window will ensure that the ICA platform is always analyzing the system's data for the next 12 months from the study time stamp. Any known new loads, planned projects, or distribution system reconfiguration occurring after the 12 months window will not be considered in the Load ICA.

3.6. Conversion of 8760 to 576 hours

As discussed in previous sections, chronological studies will be used in CYME that correlates the projects to an implementation date. If the project date and hour is not one of the 576 scenarios under study, the project will be presented in the next closest scenario (of 576) and the following remaining scenarios.

3.7. Publication

Since the GIS represents the "system configuration as is", and the ICA public map is a derivative of GIS records, only the line-sections and feeders that are in the current layer of GIS will be published. The ICA map will demonstrate the PG&E network "as is". New facilities (i.e., a new line-section), and their corresponding ICA results, will be added to the ICA Map when they are installed and are part of the "as built" layer in GIS.

3.8. Dependencies and Challenges Ahead

Load ICA refinements are highly dependent on the in-flight software developments at PG&E and there are numerous challenges that need to be addressed before implementation. As such, the plan summarized below as well as budget are estimates, not final, and subject to change. PG&E is currently drafting a detailed requirement document through discussions with its vendors and internal IT team. PG&E expects to discover more roadblocks and challenges during the development phases. A few evident challenges are outlined below:

- The ICA QA and Production environments need to be always compatible. To implement the ICA refinements, CYME 9.0 is required. PG&E and its vendors are currently using 8.1. Migration to CYME 9.0 is planned for June 2022. The ICA refinements development and testing could not be started in production environment nor the QA environment until the upgrade is effective.
- A new database needs to be developed for all load applications. This requires engagement of multiple lines of businesses within PG&E to change their processes to properly record these applications.
- A new database needs to be developed for all planned projects and planned network reconfiguration. This requires engagement of multiple lines of businesses within PG&E to change their processes to properly record these projects.
- Planned network reconfiguration changes the topology of the distribution system. Therefore, line-sections, loads, DERs, etc. that are a part of a feeder, might be transferred to another feeder after network reconfiguration. This might create some complication during publication on the data portals.

3.9. Budget and Timeline

Based on the current analysis, PG&E's high level cost estimate is $6 to $8 Million of capital investment from 2022-2025, that is incremental to PG&E's existing ICA budget. Capital investments are likely to include development of new databases; vendor engagement and software design and development; building of new IT infrastructure and interfaces; additional software licenses; publication process adjustments; development of new PG&E internal business processes; and recruitment and training of additional PG&E resources. The additional operational expenses are estimated to be about $500,000 per year that accounts for additional computational power and platform maintenance. Pursuant to ALJ

Hymes and ALJ Sisto's January 7, 2022 Ruling, PG&E will track actual incremental costs associated with Integration Capacity Analysis refinements, inclusive of any ICA refinements directed in R.21-06-017, in its Distribution Resources Plan Memorandum Accounts (DRPTMA) and seek recovery of those recorded costs in future General Rate Case filings.[11] The estimated timeline for implementation is depicted in Figure 5.

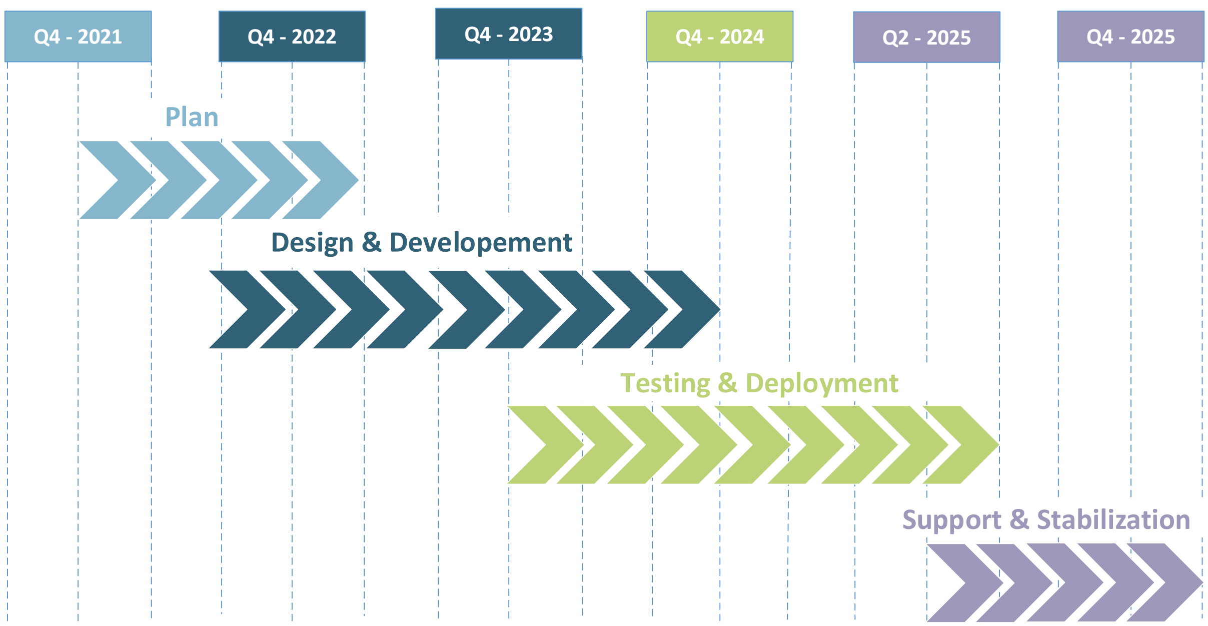

Figure 5: Development timeline

[11] Rulemaking 21-06-017: administrative law judges' ruling granting joint motion for clarification on the authority to record integration capacity analysis refinement costs, January 7, 2022.